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"How the introduction of computerised technology has effected Irish knitwear, considering design and production"

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Table of Contents

List of Plates

List of Plates

Introduction

My main aim of this thesis is to investigate what effect computerised technology has had on the Irish knitwear industry. This technology is called Computer Aided Design and Computer Aided Manufacturing, (CAD CAM). I wanted to find out this technology had the same impact on industry as the home PC has had on our domestic lives.

I first became interested in computerised technology in knitwear when I spent four months in Reutlingen, Germany, as a *Socrates* exchange student. I was fortunate that the college I was attending there had historical links with one of the world's leading knitting machine manufacturers, *Stoll GmbH.* They have their headquarters in Reutlingen and they kindly offered two weeks training on their knit courses. How advanced Stolls latest knitting machine was compared to a domestic knitting machine fascinated me. When I came back to Ireland I was curious whether Irish knitwear companies used these advanced computerised knitting machines, so my investigation began.

I found out early that very little has been written on the subject with the exception of *Knitting Technology* by David J Spencer, and *Knitted Clothing Technology* by Terry Brackenbury. These books are very technical and do not discuss what effect this technology has had on the industry. I realised quickly that I had to look at Ireland's economical and cultural status at the time to understand why this technology was being introduced. I used the *Internet* to begin my investigation and I tracked down many Irish knitwear companies who were using CAD CAM knitting machines. I have conducted many interviews with people in the knitwear industry and various institutes linked to the industry. I have looked at CAD CAM technology from a historical viewpoint and done case studies as examples of CAD CAM technology in use in the industry.

Chapter 1

Design Reform in Ireland and Irish knitwear

This chapter highlight the effects of the Scandinavian report (1962) and the design reform of the 1960s in Ireland and how they jointly led to the establishment of vital design workshops, boards and councils that have had influenced the Irish knitwear industry. The Irish knitwear industry has different sides and this will become apparent by the end of the chapter.

> "Design, a human activity centred on the conception of everyday objects, is doubtless one of the world's oldest occupations. But it was only with the advent of industrial production and later, the Modernist movement that the profession began to structure itself and develop in an autonomous way."
> (de Noblet Joceyln, 1993, pg.148)

This quote by Jocelyn de Noblet, although general statements in her book, *Industrial Design, Reflection of a Century,* could have been written about Ireland, which has a long historical design background. This includes both traditional urban and rural crafts such as lace making, silk poplin making, pottery as well as the 19th century Schools of Design. However, public awareness of design as a profession was heightened by the report *Design in Ireland* written by a group of Scandinavian designers in 1962.[1] This report is also popularly known as the Scandinavian Report.

The authors focused on certain areas of design in Ireland, some of which were Donegal tweeds, textile design and printing, linen and woollen and woven fabrics, both hand and machine knitting along with stamps, graphics and packaging. The true value of the report was not what they criticised or recommended but the extensive coverage Irish design received on an international and national scale.

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[1] For further reading see *Design in Ireland,* report of the Scandinavian Group in Ireland, April 1961, (Coras Trachtala, Feb'62)

The report,

> " A manifesto for modernism in design, was the most controversial one on the visual arts ever written in Ireland.... The authors stated 'lasting results, however, cannot be hoped for unless the vital matter of design education is tackled with energy and foresight '."
>
> (Turin John, 1995)

In general they were critical of the standard of Irish design. More importantly its fruitful results led to an attempt to raise design awareness among both the public and industry. Leading Irish newspapers covered the report and it also led to governmental changes. Ultimately it led to the establishment in 1964 of the world's first state design consultancy service, the Kilkenny Design Workshops. It was set up to promote and improve Irish design; it revolutionised public awareness of craft and design in Ireland. However, it must be kept in mind that the Scandinavian report came out at a time when Ireland began talks to enter into the Common Market. We finally entered the Common Market in 1973.

Around this time foreign industries began looking to Ireland as a new base. Companies like Digital and Analog Devices set up in Galway and Limerick respectively. These are also crucial factors that forced forward the pace of design in education and industry. Irish products had to compete with foreign ones in a free trade environment.

The success of Irish craft industries during the following decades is mainly attributed to the development policies engaged in by industries and government during that time. Some of these policies contributed to the establishment of the Kilkenny Design Workshops, Crafts Council of Ireland, An Bord Trachtala, Irish Knitwear Exporters Guild and Forbairt.

Of these agencies The Crafts Council of Ireland, Irish Knitwear Exporters Guild and Forbairt played a huge part in supporting and promoting Irish Knitwear.

The Crafts Council of Ireland was established in 1976. It is the national agency for design and economic development for craft industries in Ireland. One of its many activities includes the trade fair "Showcase Ireland". It is the only combined craft, gifts, fashion and interior fair that takes place in Ireland. It is held in January every year. It encourages home and international trade. "Showcase Ireland" began in 1977 and has become a very successful trade fair.

The fair is very important for the knitwear industry where sizeable export orders are agreed on from American and European orders. "Showcase Ireland" has a "New Face Sector" where young entrepreneurs can show and test their products. It can be an essential springboard for their careers.

The Irish Knitwear Exporters Guild was set up in 1985. It is a promotional and marketing body for the Irish knitwear industry. It started with 7 member companies and now has 29 members. The organisation offers a quality symbol, which can be used on promotional material, labels etc as seen in Fig 1. Through it's quality symbol the Guild is committed to the promotion of the best of Irish knitwear. It is a symbol of quality and excellence. The Guild discuss promotional marketing plans, trade shows and yarn fairs, fashion forecasts and many other areas that are relevant for the development of the industry. The Irish Knitwear Exporters Guild is responsible for about £35 million worth of Irish knitwear export sales. It helps to encourage and train young knitwear designers. They offer a design award scheme that gives graduates experience with members of the guild. The Irish Knitwear Exporters Guild members and buyers work closely with Enterprise Ireland to market the ever-increasing success story of Irish knitwear.

Fig 1. Irish Knitwear Exporters Guild quality symbol.
It is often used on promotional material of members.
© IKEG.

On January 1st 1994 Forbairt was established. It is a state owned and founded body with responsibility for promoting indigenous Irish industry, encouraging technological innovation and providing technology-based service to all firms. Forbairt have taken over the services provided both by the Industrial Development Authority (IDA) and Eolas. Forbairt have been restructured again and are now operating under the guise Enterprise Ireland.

Forbairt can only assist projects that are in manufacturing or internationally traded services. The aim of Forbairt is to help companies build the management and capabilities to set up and develop significant businesses. Alongside The Crafts Council of Ireland, Forbairt has been one of the most influential organisations on the knitwear industry in Ireland.

During an interview with Peter Coyle of Forbairt on the 5th February 1999 he explained to me how Forbairt got involved in the knitwear industry in the late 1960s and the early 1970s. Ireland were looking abroad to see what new developments were happening so that they would be at the forefront when were joined the European Union. International Trade Fairs were some areas Forbairt looked at.

Forbairt were operating as IIRS at that time in the 1970s and it was quickly identified that the knitwear industry was an area that they could have impact, specially as knitwear as a craft was part of our culture. In 1970 the knitting section of IIRS was established. It offered a service to knitwear companies who were adapting to computer controlled knitting machines. That service was provided by Frank Byrne, Forbairt's knit technician who I interviewed on the 30th of November 1998.

Frank Byrne joined Forbairt as a mechanic and showed interest in knitwear, in 1972 Frank Byrne got the opportunity to go to *Dubier* knitting machine builders in Switzerland for training. There he spent two years learning all aspects of knitting machines. He began on the factory floor where he learned how to build the knitting machines. Later he learned how to operate what he had built. Frank Byrne learnt all about hand operated machines before going on to learn about computer controlled knitting machines. He also spent time training with *Stoll GmbH* in both Reutlingen, Germany and Leicester, England.

Frank Byrne worked closely with the machine builders and provided Irish knitwear manufacturers information about what machines to buy. He also went on site to companies helping them to install CAD CAM technology and maintaining the new machines. A training school was in operation for machine operators and knit technicians.

The aim of the service provided by Forbairt was to help the knitwear industry. Peter Coyle stressed that the new developments in the knitwear industry were very much market lead. This meant that buyers for the retail industry were aware of the versatility of the new machines compared to the mechanical operated machines. They expected more from knitwear manufacturers, so it was more of a necessity for a knitwear manufacturer to change over to the new technology.

Peter Coyle mentioned that there was a bit of fear of the new machines from knitwear manufacturers, but those same people didn't have one mechanical machine in use ten years later. Some of the first companies in Ireland to adapt to electronic machines were *Little Chic knitwear,* Dundalk, *West End Knitwear and Tyna Knitwear,* Kildare and *Gaeltarra,* Mayo.

Most of the change over from mechanical to CAD CAM knitting machines was at its height during the eighties. As the decade went on and most companies had their machines installed and operating, Frank Byrne offered technical support and a programming service. This involved working with knit technicians and machine operators to fix problems or program new patterns. A sampling service developed where he would receive technical information on paper, such as, stitches, yarn and an idea of what kind of pattern the company would like. Frank Byrne would prepare possible samples for the company. Forbairt had a computer controlled knitting machine that was convertible to three different gauges so a variety of yarn weights could be used.

The great advantage of this service was that it developed alongside changes in the knitwear industry. It was there to service that industry and provide for its every need as the needs developed. At present Forbairt no longer need to have a support or maintenance service to industry. What it offers now is general computer training skills and a database service to the industry. It also provides a strategist planning for business. Frank Byrne works on developing storyboards and concepts for the knitwear using CAD technology.

While changes from the Design Reform of the 1960s were filtering through the government and industry, life went on. The 1970s were a great time for Irish knitwear. Several influential knitwear designers had their roots well established by the late 1970's like *Joan Millar* and *Maggie Jackson*. Some well-established industries were exporting to a healthy market in America like *Inis Meain*, who also set up in the 1970s. The American market was fuelled by *Sybil Connolly*'s work during the 1950s and 1960s with the result that Americans developed a real taste for Irishness.

Inis Meain is an example of a company using CAD CAM technology to produce Irish knitwear with a traditional image. This firm is internationally successful and is run by Áine and Tarlach de Blacam. The success of the thriving business of *Inis Meain* is rooted in history and inspiration, hard work and a quiet technological revolution. The sense of design and history of knitting skills on the island Inis Meain inspired the couple, it's namesake.

The roots of the label started here and are based on the native fisherman's dress of the Aran Islands, the intricately patterned sweater, a coarse, oiled, protective garment, knitted by the women of the island. Fig 2. Illustrates the type of Aran sweater worn in 1910. From those humble beginnings the *Inis Meain* label was created.

Today the scenario is one of international success and reputation. A purpose built white stone factory set against the patchwork of fields and the Atlantic produces 20,000 garments a year. This is due to the adaptation of advanced technological machinery running 24 hours a day. *Inis Meain* can produce 400 hand finished garments a week, which in turn are sought by an increasing clientele.

Inis Meain knitwear today use a modern translation of inherited patterns in luxurious yarns as illustrated in Fig 3. Unlike the original heavy and oiled fibres used by the women of the Island, the feel and 'handle' of an *Inis Meain* garment is soft and voluminous using the worlds finest alpaca and merino yarns for winter and linen and silk for the summer. *Inis Meain's* design theory pays homage to the traditional Aran but is further refined and defined by a disguised technology which creates the unique stitch construction.

Fig 2. 1910 Aran sweater worn by the native islanders.
© Elizabeth McCrumm

Fig 3. Examples of *Inis Meain* garments worn in the same style as the natives in Fig 2.
© Irish Independent

While *Inis Meain* was very successful abroad, hand knitters left their mark at home. By the late 1970s foreign buyers had a desire for new ideas in a market dominated by the Aran stitch. New young talented designers, some fresh out of college, others experimenting at home, were being influenced by what was happening on the London and Paris catwalks. New shapes and exciting stitches were being developed. Having had this great success in the 1970s, the Irish knitwear industry was open for further expansion in the 1980s and 1990s. According to an article published in the Sunday Tribune during the 1980s,

> "Irish knitwear has prominently been in the media since its revival in the 1980s. Gone was the taboo of granny cardi's and everyone was taking out their needles to knit a gansey".
>
> (Sunday Tribune, 29th of March 1987)

One of these handknitters is *Lainey Keogh*, who began knitting to make presents and commissions for friends. She gave up her background in microbiology in 1984 and began her professional career in knitwear. She was very influenced by what was going on in high fashion on the international scene. Her knitwear in the 80's was mostly in chunky, warm colourful yarns as illustrated in Fig 4. These were very successful in Ireland. *Lainey Keogh* began investigating new yarns, stitches that gave her a high profile in the national media.

Being aware of the ever changing fashion system she developed her knitwear greatly and now produces light, lacy, almost gossamer garments in amazingly fragile looking yarns. *Lainey Keogh* made her name on the international scene in 1994 at London Fashion week as illustrated in Fig 5. Her work is a great contrast to the traditional view of Irish knitting. She has almost 300 out workers and still uses domestic machine. She tries to resist further expansion to keep standards at present status. While *Lainey Keogh* hand knitwear may not be relevant to CAD CAM technology it is very relevant when painting a picture of the status of Irish knitwear.

Fig 4. Illustrates the work of Lainey Keogh in the 1980s when she used chunky yarns
© Womans Way

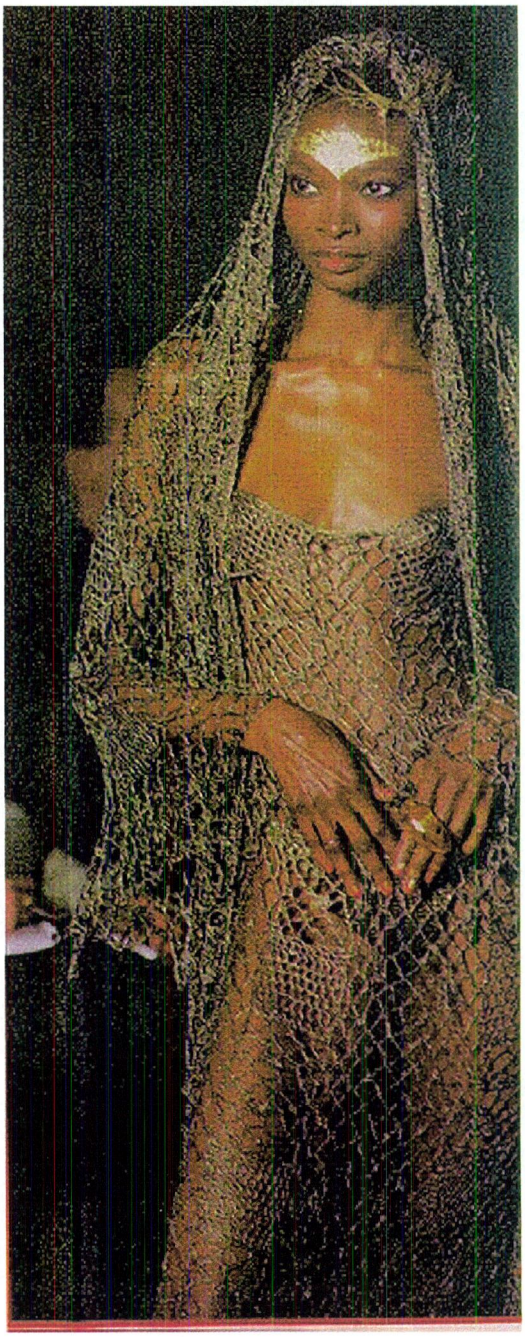

Fig 5. Illustrates Lainey Keogh's garments When she had her debut show at London Fashion Week in 1997
© Irish Independent.

In September 1992, Liberty's of London hosted an exhibition called "All of Ireland". It was a large-scale promotion of Irish goods, ranging from textiles, knitwear and clothing to pottery, ceramics and drink and food. There were three catwalk shows to promote the textiles and knitwear on display.

> "The creations of Dublin knitwear designer Lainey Keogh and Deirdre Fitzgerald, together with knitwear from the Aran Islands, will demonstrate the high fashion and more traditional aspects of the industry in Ireland today."
> (Sunday Press, 23rd of August 1992)

This show illustrated how both the traditional knitwear and the new high fashion knitwear of Ireland can survive very successfully alongside each other.

On the international scene in the 1980s, Irish fashion was a regular feature. In particular, Irish knitwear influenced many designers work, one such being *Jean Paul Gaultier*. His autumn/winter collection in 1985 was a very newsworthy interpretation of the traditional Aran. Fig 6. Illustrates one of the outfits. *Kenzo Takada*, the Japanese designer has continually admired Irish knitwear and during the mid 1980's he was getting machine knitted brightly coloured Aran styled sweaters made in county Mayo. (McCrumm, 1997, pg. 117)

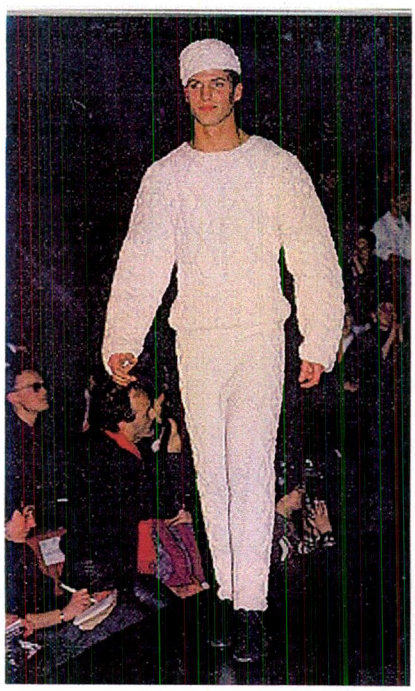

Fig 6. Illustrates an outfits from Jean Paul Gaultier Autumn/Winter collection in 1985, which was inspired by the Aran sweater.
© Elizabeth McCrumm

Chapter 2

Computer technology in the knitwear industry.

Note: Throughout this chapter, I use the word "computer". In the context I am using it, I do not mean the unit you may use in work, school or home, which may be a PC or an Apple Mackintosh, but the very core of that unit, the same core that's part of most technological appliances, i.e. "The Microchip".

Today, the computer is a fact of everyday life. As we are nearing the new millennium we may be more conscious and aware of the manifold ways in which our lives have been affected and perhaps changed by this machine. It is part of our home and work in things you may be unaware are programmed in part by computers, examples of this are a washing machine, television, VCR, microwave, photocopier. There have been mixed feelings on the subject, both at opposite extremes. Some see the computer as a threat others have embraced it and feel liberated from manual labour, imagine having to hand wash clothes again (Baker, 1993, pg. 7).

For those who have embraced technological advances, the computer has played a major supporting role over the last ten to fifteen years in disciplines as diverse as fashion and engineering. It has been seen as a tool and is used as one would use a pencil and paper.

Put simply, a computer can

> "receive, store, retrieve and communicate enormous quantities of information at phenomenal speeds. It can also manipulate, rearrange, select, marshall and transform this information. It performs arithmetical or logical processes accurately at high speed after receiving the instructions (program) and values (data) without the need for further intervention by the operator."
>
> (Spencer, 1989, pg. 122)

However it must be stressed that the computer is a tool and is only as good as the person using it. That operator could possibly be you. Contrary to some beliefs that one day we woke up and the computer had invaded the world, developments in computer technology started after World War II. It has exploded during the last ten years because of break through in the technological arena, which in turn have been influenced by consumer demands. The customer is a very important influence on all products developed.

"Granny's Christmas jumpers" in crazy colours with arms way to long is what springs to mind when most people are faced with the term "knitting". Perhaps even a little old lady in a rocking chair with large knitting needles and a ball of wool. However knitting is one of the most important methods for producing garments and across the world is established as part of every day dress. And most probably, people are wearing at least two or more knitted garments at any one time. When you think of basic clothing types like socks, gloves, underwear, t-shirts, hats, tights, jackets, you are thinking about types of garments that are all produced by a knitting process.

The technological advances I mentioned earlier greatly effected the knitwear industry, making knitting machines more versatile in their patterning scope. Fig 7. Illustrates a range of capabilities of a CAD CAM knitting machine. This does not alone mean surface decoration or textures but actual shaping of garments. There is a basic key factor underlying all knitting principles whether with two needles and a ball of wool at home or a 97" bed of needles in industry. All processes are involved in producing a loop of yarn, and feeding another yarn through it to form a new loop and so forth. What I am going to discuss is the machines in

industry, which are the result of hundreds of years of development from the two needles and a ball of wool.[1]

Fig 7. Illustrates a range of samples of garments and details that the CAD CAM knitting machines can produce. They are highly complex. The top example shows "fully fashioned" shaping and the bottom left example is a complex cable pattern. The final photo on the bottom right is a great example Multi-layer knitting and different gauges being used on one garment. Something like this could not be achieved on a domestic knitting machine.
© Stoll GmbH

[1] For further reading see "Knitting Technology" by David J Spencer, 1989

STOLL GmbH and STOLL UK.

It all began in 1878 when Heinrich Stoll moved to Reutlingen in Germany and invented the first links - links flat knitting machine. Today after over a century of further invention and developments, *Stoll* is one of the worldwide leading manufacturers of flat knitting machines, and pattern preparation systems. Fig 8. Illustrates a *Stoll* flat knitting machines which consists of at least one straight bed of needles, unlike a circular bed which is used in the construction of T-shirt fabric. It also illustrates a pattern preparation systems, which are a range of programs that can create knitting patterns, samples on screen and create a virtual sample of what a garment may look like when completed.

Stoll range of services comprises of setting up and maintaining their current range of machines, solving and fixing problems. They educate their customers' technicians on site and "in-house" in England and in Reutlingen, Germany. They work out samples for customers, and if necessary, set the machines up for the developed samples. They also offer computer design work, which helps to generate picture catalogues for use as sales material for their customer's promotional activities.

Stoll enjoys keeping open communication with their customers on a design level and a technical level. *Stoll's* slogan is "The right way to knit". The slogan is used on all the promotional material and on posters all over their headquarters. The company believes *Stoll* stands for innovation and user orientated engineering, attractively designed and processing a high level of operating comfort. *Stoll* is still a family run business.

Fig 8. This is a *Stoll* flat knitting machine and pattern preparation unit
linked up to the knitting machine directly.
On screen a virtual garment is mapped on to person.
© Stoll GmbH

CAM is short for Computer Aided Manufacturing. It is used to describe processes of making a product where the production machine is controlled by a computer.

In 1892 Heinrich Stoll was awarded a Royal Patent for the first Links-Links flat knitting machine in the world. The Links-Links machine was a simple design that allowed large amounts of knitted yarn to be produced far more quickly than by hand. The machine had double-ended needles and a carriage that carried the yarn across the bed of needles. As the carriage passed over the needles the yarn was feed through the loops already formed on the needles.

It wasn't until 1929 that the same man invented the first motor driven jacquard flat knitting machine. A jacquard is a pattern with a design or motif knitted in more than one colour. This motor driven knitting machine was a V-Bed machine. Fig 9. Illustrates a V-Bed machine, it has two liner needle beds inclined, facing one another at 100° angle.

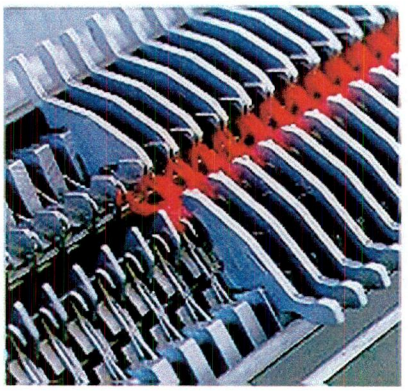

Fig 9. This is an example of a V-Bed. This means that there are two beds of needles at an angle to eachother. This photo shows beds at a 100° to eachother.
© Stoll GmbH

The knitwear industry in general adapted easily to computerised technology. This began in 1938 on the factory floor with the invention of the automatic flat knitting machine designed to produce man-made cable and braid designs. This machine was mechanically controlled, however, this was revolutionary and broadened the gap in terms of effort of making between hand-knitted garments and mass-produced garments while it narrowed the gap in terms of appearance between garments. Fig 10. Illustrates the range of *Stoll* knitting machines since 1926 up until present.

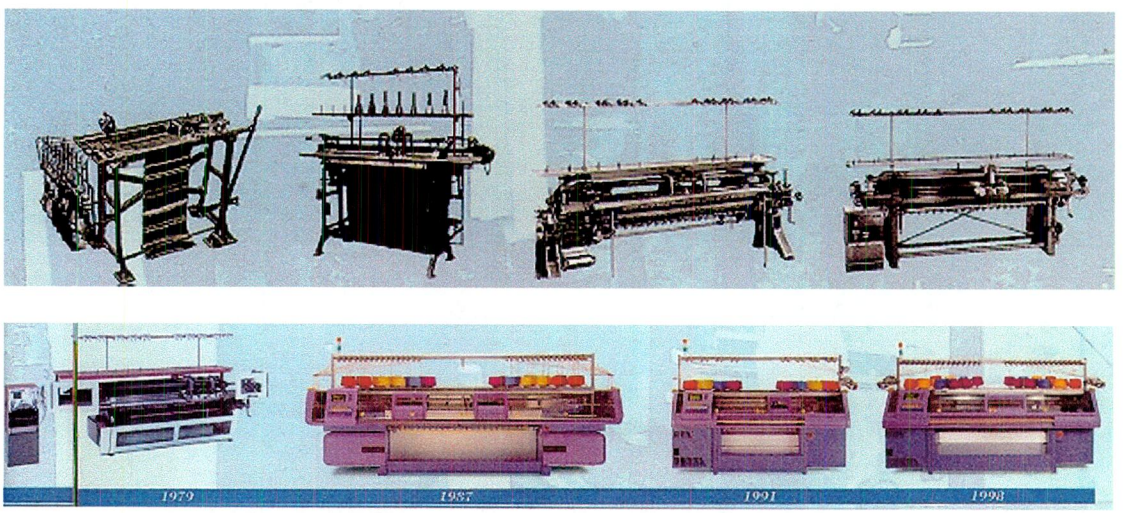

Fig 10. From the left top machine reading from left to right are the developments in knitting machines of *Stoll*, beginning in 1926 to 1998.
© Stoll GmbH

During an interview with Peter Coyle of Forbairt on the 5th February he explained that the next big development was the mechanical jacquard machine. Steel rods generated the needle selection that was necessary to create a pattern. These were called *Jacquard steels*; they had to be made in England and took a long time to make. These two factors made *Jacquard steels* very expensive and were used for many seasons. This in turn had a big effect on fashion knitwear trends that didn't vary in pattern scope each season.

Peter Coyle explained what was happening in the knitwear industry around the world. After the man landed on the moon in 1969 space exploration in the USA died down and a lot of focus was put on the textile industry, which in the early 1970s was showing potential for exciting developments. Engineers developed new fabrics, such as double jersey and cripilene. Other areas that were focused on were machinery and in 1971 at *ITMA*, the international textile machinery fair, electronics made their impact.

This impact was in the form of an electronically controlled jacquard machine for textiles. Unfortunately the engineers that developed this new technology were used to work on large budgets and the new machines were too expensive for industry. According to Peter Coyle the feeling at that time was that electronics would die out. However, the knitwear industry redesigned the electronic machines and built on its idea and managed to produce affordable knitting machines. This big development was the invention of the fully electronic automatic knitting machine in 1975.

This machine was based on electronic signals controlling knitting pattern and needles selection in the form of a long role of numerical punch card in the knitting machine. The punch cards were based on the *Jacquard steels* and too had to be made especially for every design, but the

punch cards were cheaper to produce, so a greater variety of knitwear patterns and styles were seen in shops. This punch card system seems crude and oversized, but allowed designers to exploit the possibilities for new fabrics and large area patterning.

Four years later in 1979 the first directly programmable flat knitting machine was invented. This now meant that a knitting machine operator could directly program in the instructions for a pattern to the knitting machine. At the same time *Stoll* had developed the first CAD pattern preparation unit. I will discuss CAD developments later.

The next generation of knitting machines was the CMS selectanit model. It represented a new dimension in technology and performance in knitting. *Stoll* presented this machine at the 10th ITMA in Paris. This machine lead to the development of the compact class machines in1991. A compact machine is small in size but can do everything a big machine can do and therefore is an economical machine. This generation of flat knitting machines is what the knitwear industry use today.

The newest addition to this generation is the Knit and Wear® knitting machine. This machine is special class, this means that it is the *haute couture* machine in the knitwear industry. It can knit ready-to-wear articles without having to make them up. The machine can knit multi-layers while racking. This simply means is a few layers of knitting is knitted at the one spot, while racking is the term used for movement of the needle bed in one direction or another. A needle bed can be racked four positions in either direction from normal position. The Knit and Wear® machine can use two and more gauges at once, this means that both a chunky yarn and a fine yarn can be knitted in the same garment without the machine being stopped and reassembled for different gauges.

I mentioned that the Knit and Wear® machine is the *haute couture* machine in the knitwear industry. It is the *Rolls Royce* of knitting machine. One would not use a *Rolls Royce* as a business car for a Sales Representative. It is the same principal as using a Knit and Wear® knitting machine for mass production. It would only be used for small limited editions of high fashion knitwear. In Ireland it would not be economical to use for mass production, however, as an example, if Lainey Keogh used knitting machines to create her beautiful gossamer knitwear dresses she would be the type of knitwear manufacturer to use a Knit and Wear® machine.

I have spoken about *Stoll GmbH* up until now as I have had direct experience with them while on a Socrates exchange in Germany. I know their machines better than their competitors. *Stoll's* main competitor is the Japanese company *Shima Seiki Mfg., Ltd.*

SHIMA SEIKI Mfg., Ltd.

Shima Seiki Mfg., Ltd. was established in 1962 in Japan. Their headquarters today are in Sakata, Japan. Its origins are with *Shima Seiki's* invention, in 1965, of the full automation of the glove-knitting machine. *Shima Seiki* has shown great studies in computer-aided design and manufacturing through the developments of original hardware and software. Such technological advancements have resulted in opportunities to serve a multitude of industries including textile, fashion, broadcasting, printing, architecture, automobile and industrial design. According to Shima *Seiki,* the source the source of this progress is in the spirit of the engineer and each of their employees is an embodiment of that spirit.

Shima Seiki developed their computerised flat knitting machine in 1978 but in 1995 they introduced the first commercially productive computerised Whole Garment* knitting machine. This machine could produce an "integrally" knit garment that involved little if any making up. The capabilities of this machine are similar to *Stoll's* Knit and Wear®, but with both machines to make a garment take up a lot of production time relative to the number of garments produced. It may not be cost effective for a mass production company to use these special machines.

These two companies have been competing against each other for decades and its due to their dedication that the customer is the winner. Each company

> "has progressed along separate lines and produced different machines, computers, and most important, languages to deal with the same problems and functions."
> (Brackenbury,1992, pg. 4.)

What I am going to discuss now are the currently most important developments that are in use in knitwear production are common to both companies. These are "fully fashioned" technique and "integral" technique of producing garments in industry.

"Fully fashioned" means garments are constructed from pieces of weft knitted fabric with perfect selvages, which are knitted on the machine in the required shape of the piece, such as a front or back. Weft knitted fabric is fabric in which the constituent threads normally pass from side to side of the fabric. The shapes of the pieces are generated by movement of loops at the edges to diminish or enlarge the width of the fabric.

> "When narrowing, the innermost loop of the group being moved combines with loop adjacent to it. Fig 11. Represents two loops being moved by one loop space, thus losing one loop at the edge."
> (Brackenbury, 1992, pg. 63

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* Whole garment is a registered trademark of Shima Seiki Mfg. Ltd.

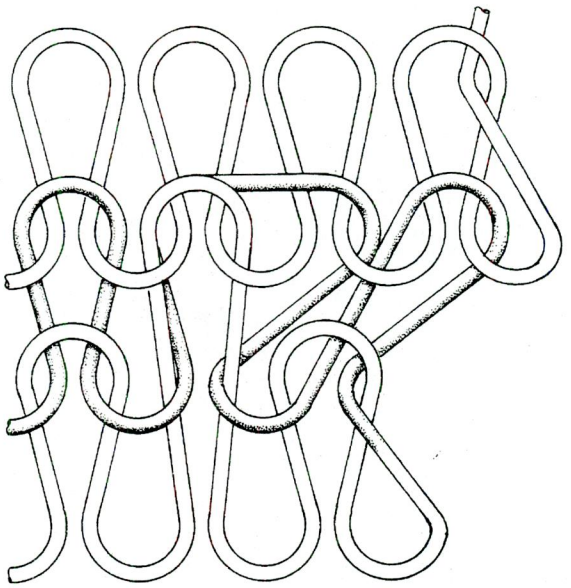

Fig11. This is a simplified illustration of selvage narrowing. Note the journey of the darker thread, where the loop that is being carried across two new loops to form one loop.
© Terry Brackenbury

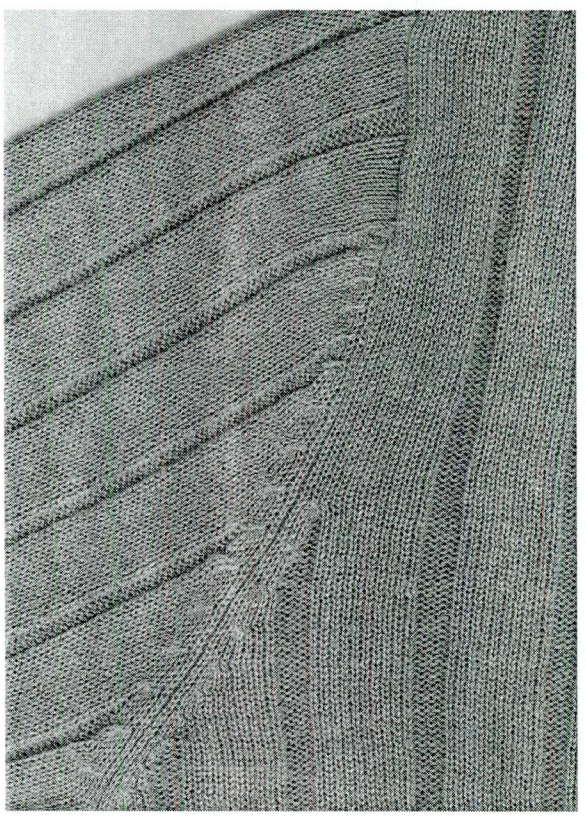

Fig 12. Illustrates "puckering" on a real garment at the selvage.
© Patricia Mc Carthy

It is possible to move more than one needle space losing more than one loop at the edge. It is only recommended on plain knitted fabrics.

> "In the "fully fashioned" industry these are known as 'needle narrowing', e.g., two needle narrowing where the outer group are moved in two needles. Such multi-loop narrowing produces small puckers where the loop combines. The number of loops in the group being moved ranges from three to seven, with finer fabrics ending to involve more loops than coarser fabrics"
> (Brackenbury,1992, pg.63)

Fig 12. Illustrates the puckering caused by multi-loop narrowing. It is like a design feature. This shaping of the outer edge of the fabric is the characteristic signature of a "fully fashioned" garment, giving a neat selvage. In industry it is often that more than one loop is moved at a time, this practice produces on even neater selvage. This allows more accurate assembly of garments.

To increase the width of a piece, the outermost loop is moved outwards, Unfortunately this causes a hole to be formed. Fig 13. Illustrates the holes being formed by widening a selvage. In industry it is professional practice to fill in these holes by dragging the previously knitted loop. Unlike narrowing, widening a piece is restricted by the formation of holes, therefore movement of one loop outwards is performed each course. A course is a row of loops formed from one or very few threads running from side to side of a weft knitted fabric. In machine knitting it is the product of one knitting cycle.

There are a number of mathematical formulas used to calculate shaping commonly used. These are translated into graphs and technical drawing which both technician and designers develop and use for production. Naturally the more the designer knows about the production process the better the designer they will be. I was talking to John Cullen, owner of *West End Knitwear* in relation to Chapter 4 of my thesis when I asked him what he would expect of a

knitwear designer. He stated that the designer's awareness of the capabilities and limitations of the knitting machines was essential before the design process was started.

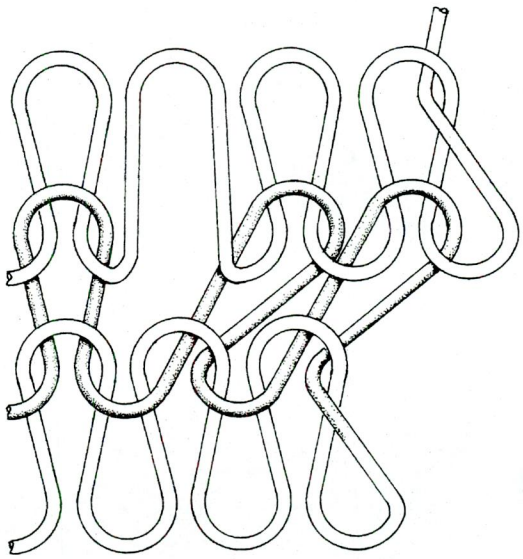

Fig 13. Is a simplified illustration of s hole being formed due to widening a selvage.
© Terry Brackenbury

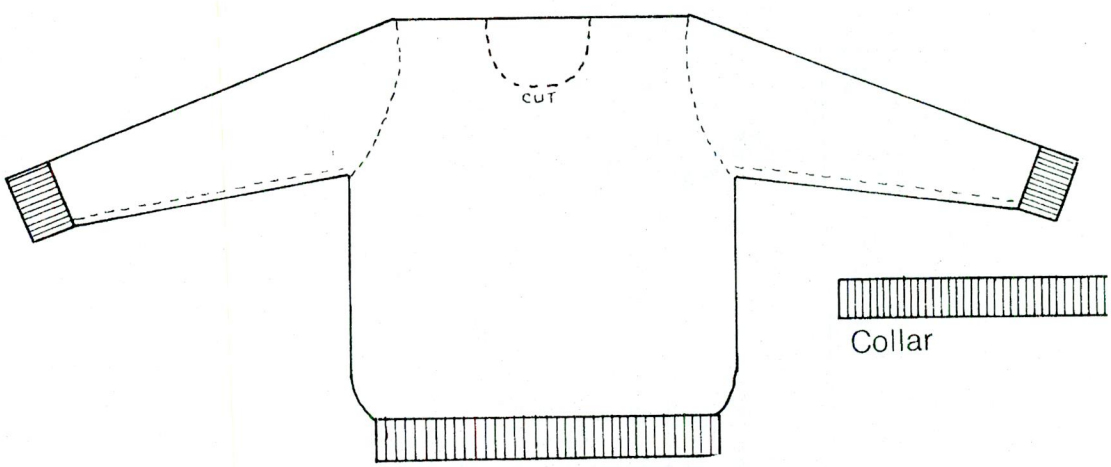

Fig 14. Illustrates what an "integral" garment would look like straight off knitting machine. The collar would have to be knitted separately

© Terry Brackenbury

In Ireland the "fully fashioned" technique is mostly practised. Since the beginning of the industrial mass production of knitted garments, there has been concern over the waste element using the "cut and sew" technique. This technique required large lengths of knitted flat fabric from which garment patterns were cut. There could be as much as 50% wastage. It is widely recognised that using the "fully fashioned" and "integral" knitted methods of production, lowers if not eliminates waste altogether.

"Integral" knitting is a progression from "fully fashioned" knitting. "Integral" knitting produces weft knitted garments constructed so that they require little or no cutting, and little or no sewing operations to finish them. Fig 14. Illustrates an "integrally" knit garment.

The reasoning behind this development was to produce a garment that had little or no making up. Theoretically this would cut down on assembly time therefore would be amore cost effective method of producing garments. However, in reality this method of production produces fewer garments than the "fully fashioned" technique in the same length of time. This increases garment costs and if a fault is detected the whole garment must be discarded.

In industry the high capital involved in acquiring computerised knitting machinery is obviously a central issue. Initially there are two main inhibiting factors,

1) The added skills needed on the part of the designers, machine technicians and programmers to deal with this new technology. Training and time for learning must be allowed for.
2) The added cost of buying the machinery and adapting factory space.

All these factors cost money especially when added to overheads. Fortunately these factors are only involved with initial adaptation to computerised machinery.

A constant factor is the increased machine production time involved in both "fully fashioned" and "integral" garments compared to "cut and sew" technique, even though the machine is operated for a longer time productivity is decreased. However, it is balanced by decreased time needed for assembly.

CAD is short for computer aided design. It is used to describe the stages whereby a computer is used to assist in designing a product. I discussed earlier in this chapter that both *Stoll* and *Shima Seiki* manufacture similar machines which produce a "fully fashioned" or "integral" garment but also that they differed in other aspects. The most noticeable area of difference is their methods of using CAD.

In the design room of a knitwear manufacturer you would find their CAD software being used alongside pen and paper to design a new collection. The great advantage of using computers when designing is that a computer can store vast amounts of information. There is often no need to sit down at a desk with paper each time to come up with new design ideas or if an alteration is required. Once a pattern has been worked out the information can be stored. Later it can be retrieved and re-assembled into a new product.

Before computers became part of every office, designing a collection was done by hand on paper. Often sampling on the knitting machine went hand in hand with design development.

This approach is still favoured by many smaller companies, but for a large knitwear company it is not time efficient and very labour intensive. The designs in a large company may vary little each season. For companies like this it is easier to produce a new collection by retrieving styles from the computer.

The design software used in the knitwear industry is developed specially. A company would buy from the same company that developed the knitting machine used in their factory. Machine builders develop software that is particular to their knitwear machines.

There is programming software and design software. *Stoll* call theirs "Sirix 110" and "Sirix 210" systems. These are pattern preparation units and automatic knitting programs. *Shima Seiki* call theirs "SDS Automatic software" and it is a computer graphic apparel design system. Programming software is what is used to write a pattern. Fig 15. shows an example of *Stoll* automatic knitting programming software called "Sintral". "Sintral" is similar to programming languages in other computer disciplines that is the "language" is made up of letters, numbers and symbols.

With *Shima Seiki* programming software, colour is used to represent information. Each colour represents a line of information or a stitch type, an example of this is, blue could mean a tuck stitch. Fig 16. Illustrates an example of *Shima Seikis* programming language. It is an actual print-off from the "SDS Automatic software" computer. Once a pattern has been programmed it is saved on a memory card which can be inserted into the knitting machine.

Stolls "Sirix" pattern preparation unit's enables the generation of garments from the initial pattern design to the finished garment. You simply scan in knitting patterns, process them and develop whole collections on screen with realistic looking stitches.

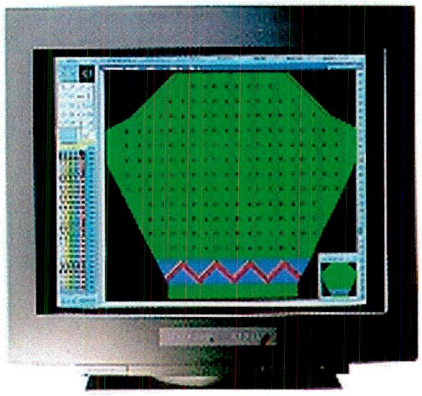

Fig15. This is an example of a "Sintral" automatic patterning program from *Stoll*
© Stoll GmbH

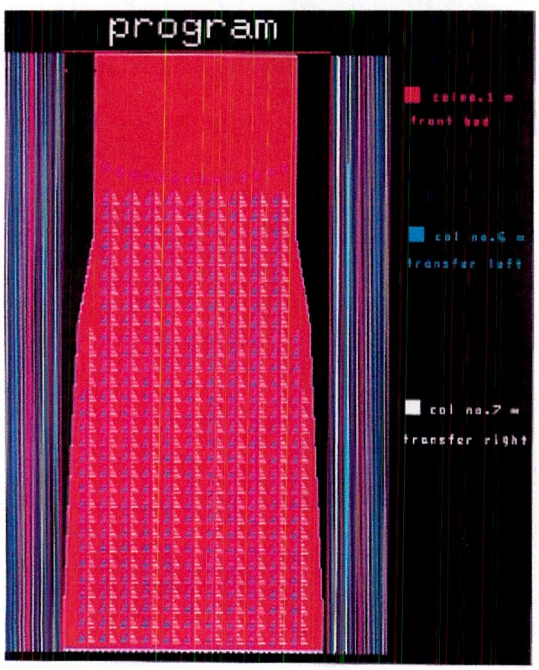

Fig 16. This is a good example of *Shima Seikis* patterning program. The program is written in colour code.

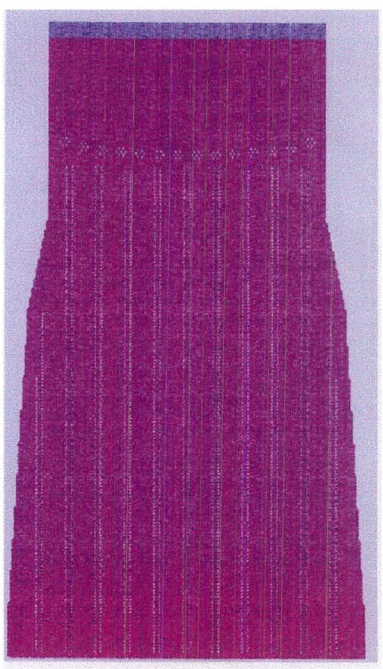

Fig 17. Illustrates *Shima Seikis* virtual stitch sample that can be produced on screen.

© Enterprise and develpoment course in fashion Knitwear, Limerick

The realistic looking stitches are called Virtual Stitch Design. Fig 17. illustrates the virtual stitch image of Fig 16. The virtual stitch image looks like a scanned image of a real knitted sample. On the computer screen you can build up a virtual pattern that looks like a scanned picture of a knitted garment. It then can be translated into a pattern programme. This kind of technology gives companies great advantages. Firstly it can cut out time lost by manually writing out a pattern for a sample, and it cuts down sampling time on machines especially if the machine is needed for production. All design development can be done like this and presented to customer s before ever being made into an actual garment.

Pattern and texture elements are retrieved from a file. Using "Sirix"210 your patterns can be displayed in 3D on the screen and drape the pattern on a computer generated model as illustrated in Fig 18. The garment automatically takes the shape of the body. "Sirix" can automatically check your knitting program, calculate the yarn consumption and knitting time. Then when you are ready to knit, "Sirix" transfers your program through a communications network to the knitting machine and monitors the entire production. Fig 19. and Fig 20. Illustrates the many uses of the "Sirix" systems.

The only disadvantage to this technology is that it is very expensive.

All this information in this chapter becomes more understandable and clear when put into practice. In Chapter 4 and 5 I have completed case studies on individuals and a company, respectively, that use this technology at work.

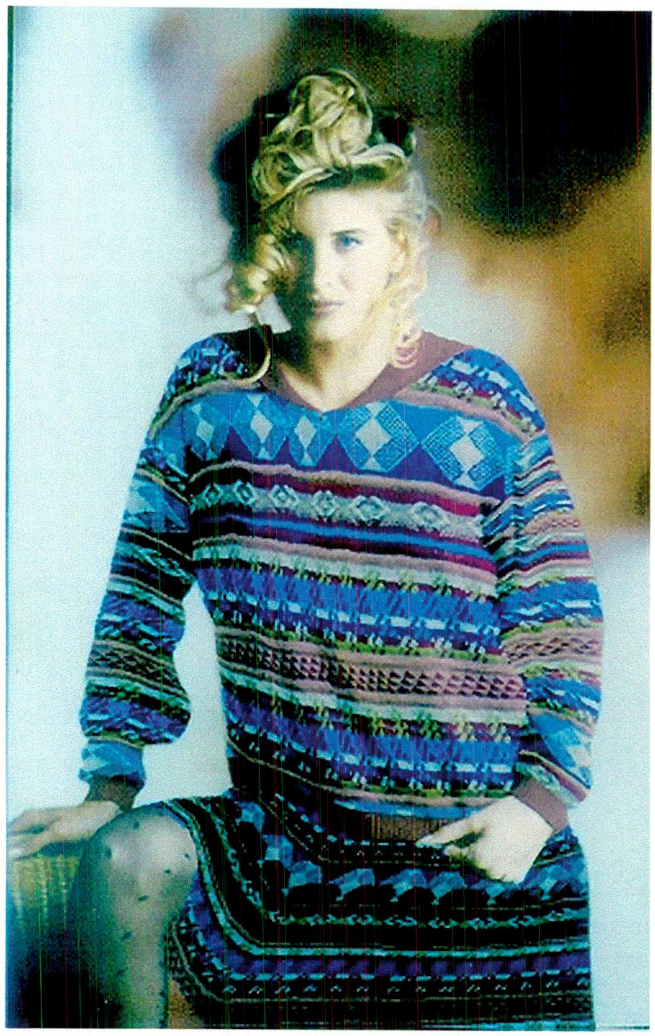

Fig 18. Illustrates a computer generated model
with a virtual garment draped onto the body in
the form the garment should take.
© Stoll GmbH

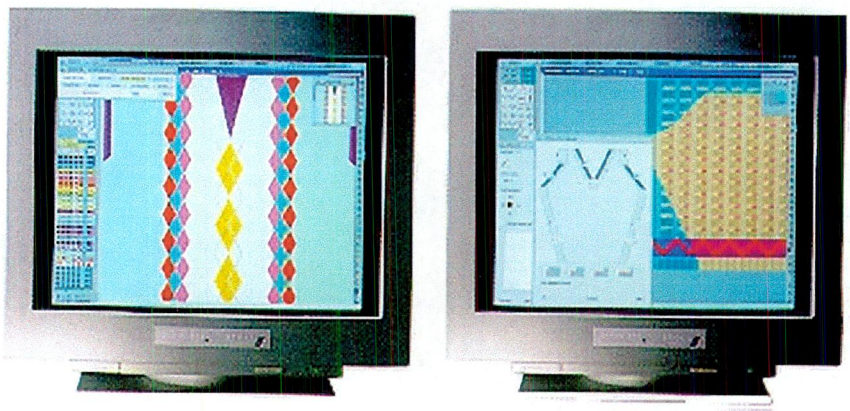

Fig 19. and Fig 20. Are both examples of *Stoll* pattern preparation units.
Fig 19. illustrates an fairisle knit program while
Fig 20. Illustrates "fully fashioned" pattern shaping.
© Stoll GmbH

Chapter 3

CAD/CAM Training for the Irish knitwear industry.

The Irish knitwear CAD CAM training course was briefly mentioned in Chapter 1, in discussing The Crafts Council of Ireland. As mentioned earlier in that chapter many policies were introduced by the government and industry itself, which have had lasting results on Irish design awareness. To teach designers to produce a commercially viable product was one of the main aims dealt with on the various courses set up by The Craft Council of Ireland.

In 1994 The Crafts Council of Ireland in collaboration with Limerick Institute of Technology and Forbairt set up a training course for fashion graduates to teach them how to use the advanced technology being used in the knitwear industry. The course is supported by the ESF through the Innovatory Actions for Vocational Training and Employment. Forbait funded the CAD CAM technology and subsequent technical skills training.

The primary short-term aim of the project is to train people with proven creative talent, but who are not CAD/CAM literate, in the technologies that have been rapidly adapted by the Irish knitwear industry. The long-term aim is to enable Ireland to protect its established markets and develop new ones by training our most talented knitwear designers in advanced design and production technologies. Investment in innovative production technologies is not in itself enough to maintain the growth of the knitwear industry. Ireland can only maintain long term competitiveness by staying at the cutting edge of design.

Enterprise and Development course in fashion knitwear, Limerick

Initially the core of the course was training of CAD CAM skills. It was done on the knitwear systems more commonly used in the Irish knitwear industry, i.e., the *Shima Seiki* systems. Lucy Erridge, an experienced knitwear designer is Programme Supervisor for the course with the aid of Margaret Ryan as technical supervisor. Margaret Ryan is a graduate of the course. The Visiting lecturers experienced with the *Shima Seiki* system and fashion consultants from industry have input with the course as mentors or for additional training.

In the first few years of the course most emphasis was on CAD/CAM skills and a long placement is industry. The course organisers felt more time needed to be spent on design and product development. So in 1996 the course was restructured and the Enterprise and Development course in fashion knitwear was established. The main aim of the course is product development, so that graduates could set up there own business or become a useful asset to the knitwear industry in Ireland.

During my interview with Patricia Kielty on the 27th of October 1998, she discussed how a saturation point of qualified knitwear designer with CAD/DAM skills might occur. She highlighted that the Enterprise and Development course produces a designer that is multiskilled, so many graduates can go into freelance design or consultancy for industry. The main aim would be that these graduates could benefit industry and be very aware how a business is run.

Elaine Curtis and Brenda Ahearne graduated from the course in 1997 and now run their own successful knitwear business. They are both good examples of the results of the Enterprise and Development course.

Interview with Elaine Curtis. 5.30p.m. 24/11/98. Powerscourt Townhouse.

Elaine Curtis went straight from degree to the Enterprise and Development course in Fashion knitwear in Limerick Institute of Technology. She was fortunate to be in her degree year the year the course did not run. She had total access to *Shima Seiki* machine while it was lying idle and one on one tuition with the tutors. Elaine Curtis felt it was a wonderful introduction to CAD/CAM technology before starting the Enterprise and Development course from which she graduated in 1997.

During the course her design process stayed practically the same as degree year where she would sit down and develop designs on paper initially and then try and translate into knit samples. When it came to sampling Elaine Curtis at first thought the *Shima Seiki* machine would do the work for her, but she soon found out otherwise. She had to adapt and assemble stitches already programmed in the knitting machine to create the samples to match her design ideas. As part of the course an intensive training block is spent learning how to create and program in new stitch ideas. This is very important, as each participant has to develop a product over the 12 months of the course, which must following a business plan they have set for themselves.

Elaine Curtis did her degree thesis on fashion as a business and was turned off starting her own business. But as the course went on she got a lot of encouragement to set up on her own. She slowly began to have a change of mind. She knew it might be her only way to stay in Ireland and also to work in something she liked.

Elaine Curtis officially started her business in October 1997 and is based in Carlow. For her first collection she used the *Shima Seiki* machine in the college to do sampling of knit ideas, which she would use as reference shown with designs when approaching a manufacturer. Elaine Curtis didn't continue that process because it was too expensive as it cost approximately £20.00 an hour once you have graduated. She realised what a bonus it was a student to have it there when you need to work on it. Fig 21. Illustrates two garments from her first collection, which was completely produced on the *Shima Seiki* knitting machine.

She said she changed a lot throughout her first year in business. Having to use what is at your disposal has a great influence on your design work. She had to adapt back to a domestic machine. Elaine Curtis used to work with very fine yarns on the course because the CAD CAM knitting machine gives the option of using different gauges. She would normally have used gauge 10, which means that there are ten needles per inch on the knitting bed. Elaine Curtis now has developed into chunkier yarns, as gauge 5 or 7 is the average gauge of a domestic machine. It is possible to use a fine yarn on a domestic machine but the resulting garment would not be of the same quality as a garment produce on the CAD CAM knitting machine with a larger gauge. It would have a lot looser stitches.

Fig 21. Two outfits from the first collection by Elaine Curtis.
© Elaine Curtis

She contracts out a lot of her work to out-workers using domestic machines, both in Dublin and Carlow. She also has a manufacturer using CAD CAM technology producing some of her work so that her collections have garments produced with very fine yarns. This reflects the kind of garments produced while on the course. She feels anxious about the costs involved to get garment produced in a factory. This cost does not alone involve production costs but also sampling costs. She has to work out exact samples and stitchwork before going to the factory; however, it's possible for the factory to do it for her. She feels its necessary for her to do her own sampling so she is perfectly happy with the result. There the manufacturer and Elaine Curtis discuss if they can do the stitchwork and sometimes it's possible to make improvements.

Forbairt have been very helpful to Elaine Curtis in helping work out stitch substitutes for her manufacturer. Frank Byrne being the knit technician up until the early 1990s still will help out companies if they are in need of guidance. She said she would never sit down at a knitting machine and start designing before design development on paper had started. Her sampling is done alongside design development as she feels that it allows her to be more open to new creative ideas to produce a tight collection.

Elaine Curtis has the help of a lady who is very good at fine tuning stitches and working out stitch problems on the domestic machine. With her help she has created a library of stitches and patterns which can be referred to for forthcoming garments. She mentioned that now she has the knowledge of stitches and manipulation techniques built up in her head it is easy to visualise the sample before its worked out fully. She feels though that a domestic machine is limited in what it can do in relation to stitch and pattern possibilities that can be achieved using CAD CAM technology, but would never knock the domestic knitting machine. It is what she has to use now and is perfect for some of her collections.

It is feasible for Elaine Curtis to get garments produced in a factory but comparing it to her out-knitters when doing costing, it is a huge percentage of her costs. She stated that now she is using CAD CAM technology more to get garments produced, but is worried about the cost of doing samples.

Elaine Curtis feels strongly that she wouldn't be doing what she is now if it wasn't for the course. She stresses that you do only get out of it what you put in. There is a huge amount of information about business and technical skills in knitting available, but its what you make of that information that is important. You will only get so much direction and its left up to you after that.

Elaine Curtis felt the course was very technical, more so than business orientated or creative. Sometimes she admits it drove her mad when things went wrong on the machine and you may find out a week later what went wrong. Her ideal circumstance would be to liase with a technician who would do her sampling while she focused on design work. She thinks you can only be one or the other.

When asked whether now with her knowledge of knitting that she can design better garments, her response was she would imagine so. It was something she never sat down and thought about but feels it would make sense.

Elaine Curtis met Ciaran Sweeney, whose hand painting is his trademark at a number of shows and award. They were asked to collaborate to produce some work. From there they have shown and advertised their work together. Fig 22. Illustrates two outfits that are pieces from their separate collections. The garments are worn beautifully together complimenting both

designers work. At the moment they are still independent designers, but do discuss together their collections. Somehow they complement each other very well.

Fig 22. Illustrates two outfits by both Elaine Curtis and Ciaran Sweeney.
Their garments compliment eachother.
© Elaine Curtis

Interview with Brenda Ahearne, 2pm, 7/11/1998 Café Mocha

Brenda Ahearne graduated from the Enterprise and Development in fashion knitwear at the Limerick Institute of Technology in 1997. Her first collection *Electronic Sheep* for winter 1997/1998 comprised knitted hats. Her hats were very successful in Ireland and Germany. She wants to expand the label into garments and accessories. Brenda Ahearne recognised the importance of strong branding stories to promote to clothing market. Her innovative promotional vacuum packaging of last year is succeeded this year by point of sale packages of photographs and postcards. These are out takes from the forthcoming electronic sheep catalogue, which features the adventures of the electronic sheep character landing his space ship in New York city and hanging out with his new companion Pandora Silvertip. Fig 23. Illustrates a mini catalogue promoting her *Electronic Sheep*.

Future plans for electronic sheep, building on the concept of strong but discreet branding include a fabric garment range to complement the knitwear, a branded T-shirt range and the launch of *Electronic Lambs*, a range of knitwear for street–wise, style conscious babies. Brenda Ahearne sells electronic sheep through Dublin shops, *Tribes*, *Sabotage*, *The Kilkenny Shop*, *Circa* in Galway and *Shindig* in Tralee.

Brenda Ahearne stressed to me she would never have been able to set up her business if it were not for the Enterprise and Development course in fashion knitwear. Like Elaine Curtis,

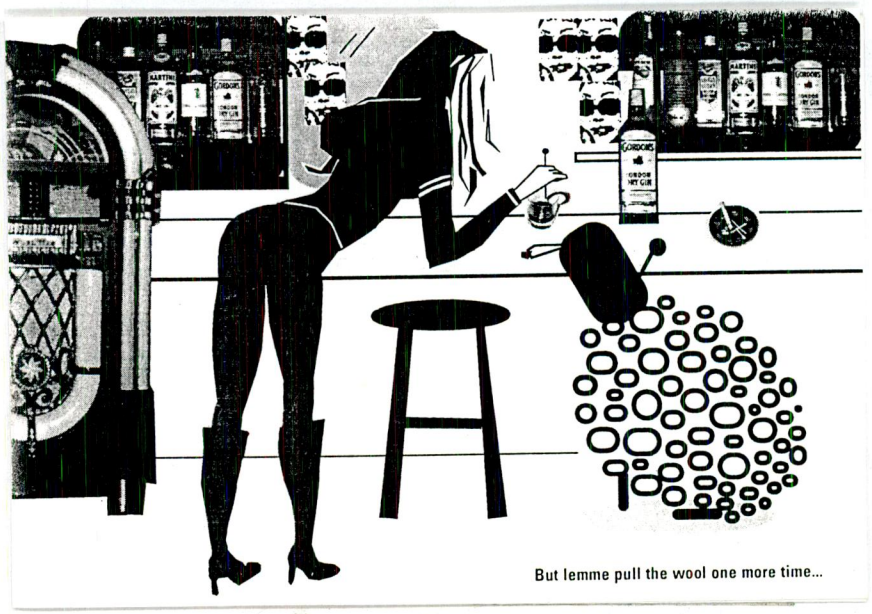

Fig 23. Is a mini catalogue from Brenda Ahearne's *Electronic Sheep* collection. The front illustration is of Pandora Silvertip and the *Electronic Sheep* on adventure.
© Brenda Ahearne

Brenda produced all her hat collection using the CAD CAM technology in Limerick Institute of Technology, and like Elaine Curtis too, she felt it just wasn't feasible to continue working on it for future collections. Through the course she sourced a feasibility grant to research into and find a manufacturer. She found a manufacturer in Manchester. Their machines were limited in capabilities compared to the knitting machine used on the course. It was an old version of the electronic machines and all she could get produced was single bed knit with pin tucks to create surface texture. The garments were produced using the "cut and sew" technique. As mentioned in Chapter 2, "cut and sew" means a length of fabric is produced and then used like any fabric where a pattern is cut from it and sewn up. Having her garments manufactured in Manchester meant she couldn't maintain quality control unless she travelled to England, which was turning out to be very expensive.

She has now sourced a manufacturer in Belfast. This company is family run and is very interested in using the CAD CAM technology to the best advantage. She hopes to work with this company for future collections. Unfortunately knitwear manufacturers in Ireland are constantly being undercut by outside manufacturers especially from the Middle East. It comes down to pennies when producing garments cost effectively. Due to this most Irish manufacturers don't like taking on small companies or individuals as contracts.

Brenda Ahearne had produced beautiful samples while doing the course in Limerick but she couldn't use them because not one manufacturer would take her contract. They could not produce garments based on those samples cost effectively or they were too time consuming. She said that doing the course broadened her view on producing garments, and began thinking industrially. Fig 24. Illustrates a menswear sweater and hat form her latest collection.

Fig 24. Is a menswear sweater and hat by Brenda Ahearne from her *Electronic Sheep* collection.
© Brenda Aheanre

Up until she did the course she always used a domestic machine and normally one would never produce mass amounts of any one garment. In college she was free to be creative and created one off very decorative garments. The course makes you aware that being money orientated in thinking is necessary to be successful and to continue producing complex garments was unnecessary for her market.

When I asked about her design process now she remarked that she had to go back to her way of developing design ideas before doing the course. It was because of monetary reasons, she said computers could never really eliminate the initial design process on paper. This process always begins on paper developing shape and detail ideas. She renders her developed

designs using *Adobe PhotoShop* graphics software. This software can be put on any computer at home. This means she can make lots of copies of designs and experiment with colour ideas and combination of garments using minimal amount of time compared to redrawing everything by hand. Brenda Ahearne works up her promotional design work on the computer.

Unlike Elaine Curtis, Brenda Ahearne is very happy to have whomever her manufacturers will be to do all her samples. Normally a manufacturer wouldn't charge for sampling if a contract were sure to come out of it. This production is a plus for small design business. She would go the manufacturer with her design work and the yarn she would like to use. She would normally source this at trade fairs. Brenda Ahearne and the manufacturer would discuss what kind of details and pattern she would like on her garments and sort out the best way to achieve them. The knitwear manufacturer would then begin sampling for her. When She was happy with the samples production could start.

Brenda Ahearne believes that this is the way for the Irish industry. She thinks that the only way a manufacturer will be able to survive is to stop trying to compete with the Far East and large foreign manufacturers and focus on contact work from designers. Then there will be a need to use the CAD CAM technology to its full capacity neglecting the restraints forced on manufacturers producing mass production for the middle market. The market will be of a higher standard so that a little more expense will be allowed when producing garments.

Chapter 4

West End Knitwear

West End Knitwear is a family run business in Monasterevin in Co. Kildare. Molly Cullen formed the company in 1957 to support a young family. It incorporated a family knitting tradition whose heritage stretched back for over a hundred years. Molly Cullen was the first craftswoman in Ireland to commercially market her domestic machine knitted woollens. She produced baby and childrenswear clothing, which she sold locally. Her sons John and Paul are the present owners, and are proud to continue the long knitting tradition in their family.

Today, *West End Knitwear* is the biggest knitwear manufacturer in Ireland; it is a modern company with a young energetic workforce. It is conscious of its roots in the past but the company has its eyes fixed firmly on the future. Geographically its situation in the west end of Europe has been part of its success. *West End Knitwear* takes pride in being the first company to manufacture garments, which were originally produced for fishermen, but have now been adapted for modern world-wide markets. Fig 25. Illustrates two of *West End Knitwear* modern adaptations of traditional Irish sweaters.

West End Knitwear sells under brands names like, "Crios", "Arancraft", "Cotton Country" and "Celtic Country" as illustrated in Fig 26. It has also the capacity to do large contract work. Its main products are Shetland, Alpaca, and Merino wool's, and cotton and linen. *West End Knitwear* has large number of machines ranging in gauges from 3 to 7; these means mainly thick yarns are used.

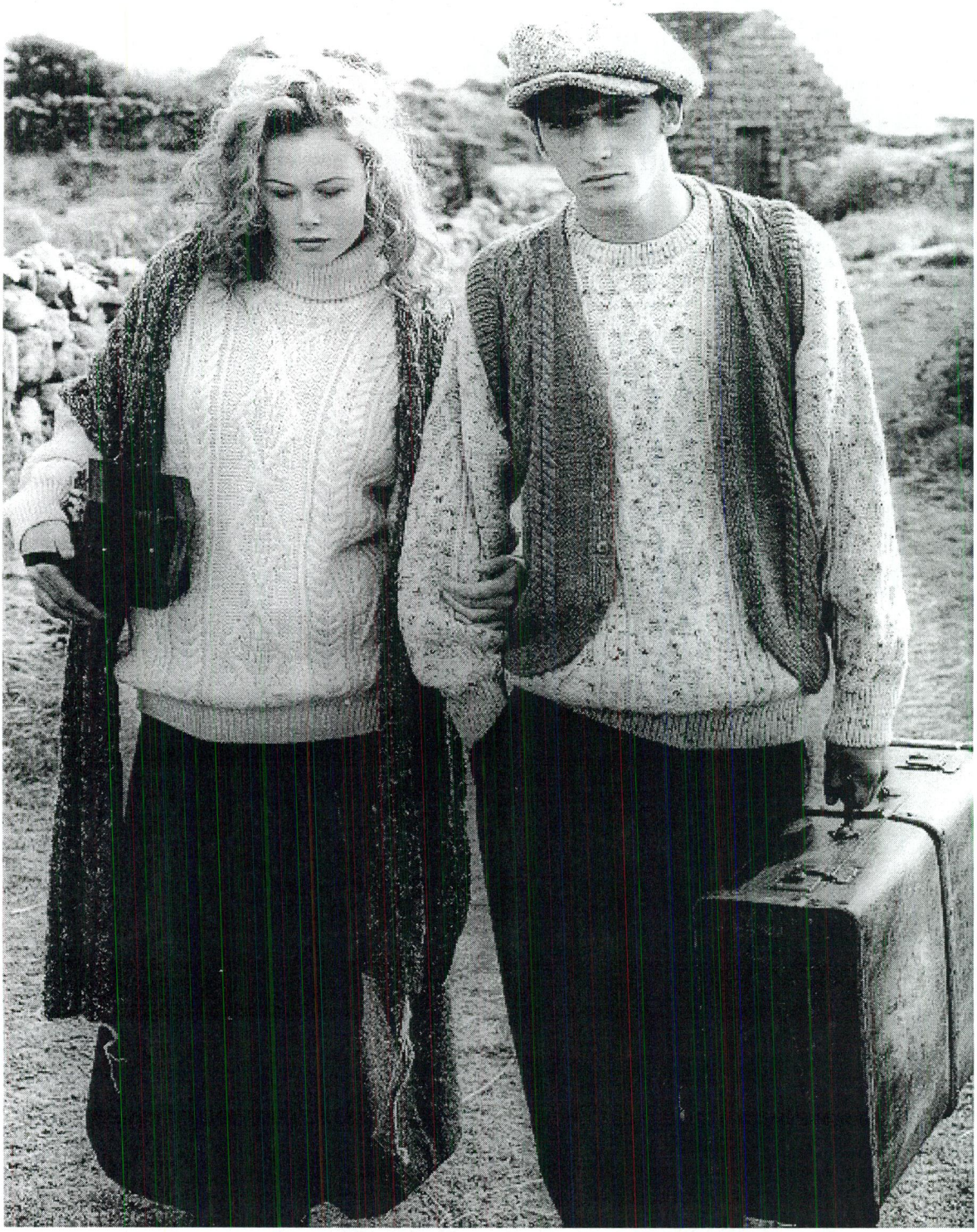

Fig 25. Illustrates two garments from *West End Knitwear* Autumn/Winter catalogue.

© West End Knitwear

Fig 26. Illustrates *West End Knitwear* brand labels.

West End Knitwear's main market is the United States. It sells vast numbers of garments, worth about 2.5 million Dollars, on the American shopping channel QVC. John Cullen goes to America at least twice a year to promote the company's products. Some of it's other clients are Penney's, Dunnes Stores, and during the 1980s, Top Shop. *West End Knitwear* has the capacity to produce 9,000 garments a week. It works three shifts over a 24-hour period. *West End Knitwear* employs 75 people. That breaks down to about 40 in production, 25-30 in assembly and packaging and the surplus in administration.

In a knitwear manufacturer like *West End Knitwear* the production a garment takes many stages. It is peculiar is some ways as the factory is spread all over the town. The actual production of the garment pieces is in the same building as the design rooms. It is in this building where all the important decisions are made.

West End Knitwear has an extensive archive of stitches and patterns. This library of information saves time when creating a new product. The production process runs as follows.

In Chapter 3 under the sub-caption of CAD, I spoke about the use of software that enables a designer to produce a virtual sample. I also explained that this software is very expensive. John Cullen and his design staff use the standard computer equipment used in an office to produce a similar virtual sample. First of all in the design room ideas for a new collection are developed on paper. The designer will then look through the files of past seasons to see if old styles can be adapted. These files of past seasons are kept both on the computer and as paper references. A small knitted sample of the garment is attached to the paper reference. If a pattern of an old style can be used it is reworked using *Adobe PhotoShop* software graphics. This graphics software can be used on any standard PC and is inexpensive compared to *Stoll*

software. Firstly the knitted sample of the pattern is scanned, then the designer uses tools that are part of the software to manipulate stitches and fuse the pattern on screen to form a new sample. Fig 27. is an example of *West Ends* PhotoShop sample. The end visual result looks similar to the virtual sample created on the *Stoll* software. *West End Knitwear* uses existing patterns that are in their archives. It is easy for the programmer to create a new pattern programme for the new product.

Fig 27. *Adobe PhotoShop* virtual knit sample used by *West End knitwear.*

© West End knitwear

There are added advantages in using software graphics to create samples. *West End Knitwear* can send these samples by email to customers in America. The customer will then decide if they want changes made or not. All the changes can be made ever before an actual knitted sample is made. This cuts out time often wasted knitting up samples on a machine otherwise being used for production.

When interviewing John Cullen on the 14th December 1998 we discussed using this method with Irish clients. He said that Irish clients are slower to make decisions on samples shown on paper, they like to see a real knitted sample. John Cullen mentioned that a couple of years ago the same clients would never have looked at a virtual sample, but now they do. He is very happy that methods are changing. He also mentioned that American clients are faster to make decisions on a virtual sample because of the obvious difficulty in time needed to send samples back and forth between America and Ireland.

Once initial changes are made a knitted sample of a full garment is made. At this stage American and Irish clients come to *West End Knitwear* to make final decisions on an order. John Cullen and his designers may travel to the client. Naturally it is easier to meet more regularly with Irish clients. During these stages there is constant interaction with the programming technician so that production can begin once changes to the garment are finalised. Throughout design development yarn sample are shown with the designs. *West End Knitwear* deals mainly four yarn suppliers and once a yarn is decided on they can order in bulk for production.

The next stage in the production process is knitting up the garment pieces. Both the programme technician and the machine operator receive a specification sheet detailing all

information required for production and a technical drawing of the garment. Fig 28. Illustrates a real specification sheet from *West End knitwear.*

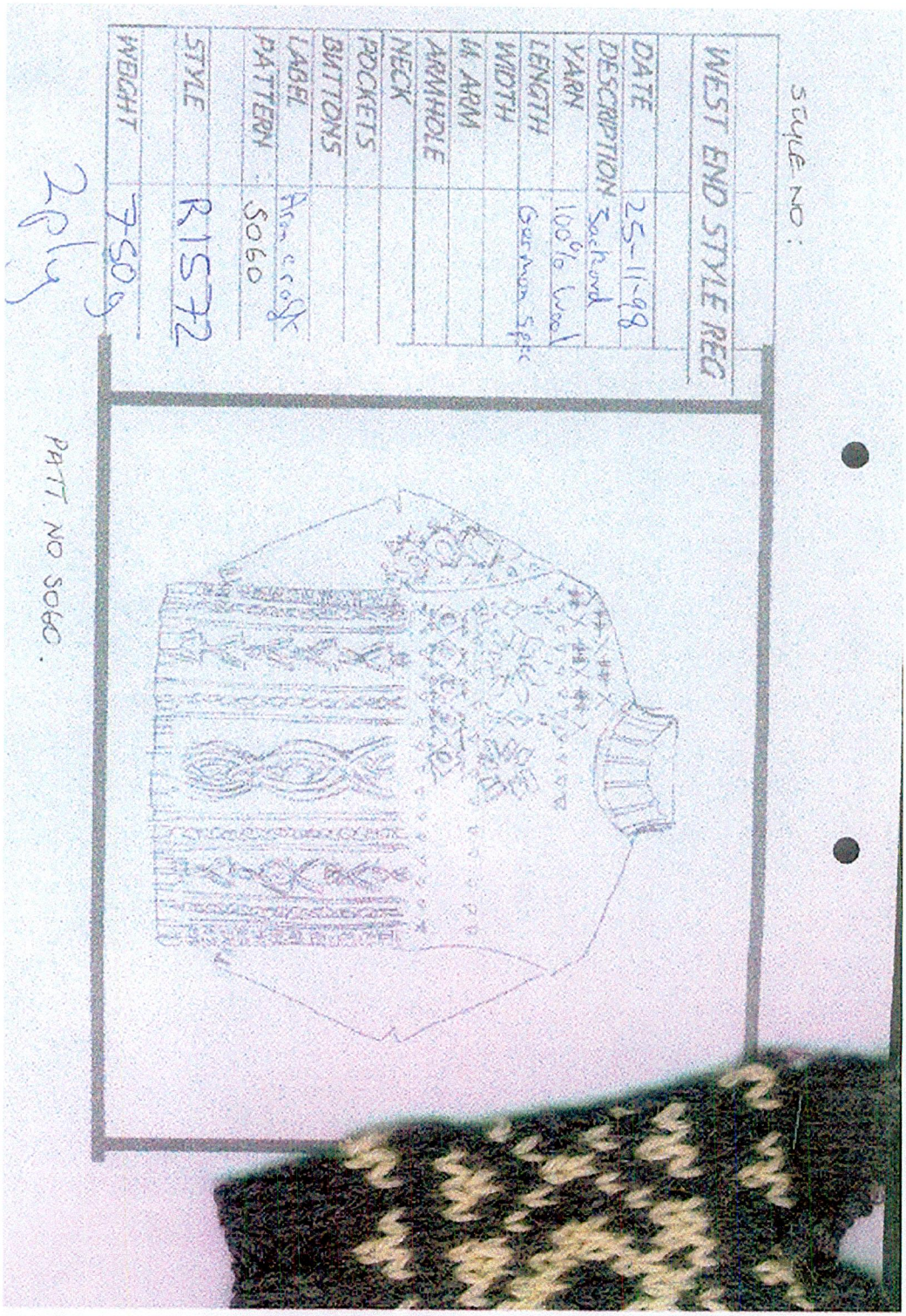

Fig 28. Is a specification sheet used in *West End Knitwear.*

© West End Knitwear

On the production floor the garments are produced using the "fully fashioned" technique. *West End Knitwear* has 22 machines. Normally a "fully fashioned" garment has the neck shaped in the knitting process, *West End Knitwear* do not do this. It knits a garment piece that can be either a front or back. Later in the assembly line the necklines are cut out.

Up until four years ago *West End Knitwear* used the "cut and sew" method of production, however machines became available to produce using the "fully fashioned" method. There was pressure to adapt to "fully fashioned" production because European costs was rising. *West End Knitwear* still produces a small amount of garments using "cut and sew". It will continue to do so as *West End Knitwear* are now beginning to produce homeware products, such as curtains, cushions and throws.

Once a batch order of garments are knitted they are bundled in sizes and quantities. They are then sent down to another building in the town to be assembled and packaged. The next stage in the process begins with steaming. All the pieces are steamed o it is easier to assemble and later package. At this stage all waste yarn is taken off the pieces. Fig 29. Illustrates what the garment looks like coming off the knitting machine as "fully fashioned" pieces. Between the waste yarn and the actual piece a separation yarn is knitted in. This melts away when pieces are steamed.

Next the necklines are cut out. *West End Knitwear* has a special cutting table that is operated by a person, which has a pressure lid. On the table surface a blade for the front or back neck is placed. Garment pieces are laid down being positioned properly by aid of markers on the table. The pressure lid comes down and the neckline is cut. There are different size blades for different size garments and styles of garments.

Now the garment is ready to have the side seams sewn up by machinists. A special overlocker designed to sew knitwear is used. After the seams are sewn the sleeves are put in. Next along the assembly the neckbands are sewn on with a banding machine developed for knitted garments. At the end of the assembly line a team of finishers check garments for faults and trim off excess threads. Once garments pass their inspection they are handed over to packaging. Here a team steams the finished garments and check for stains.

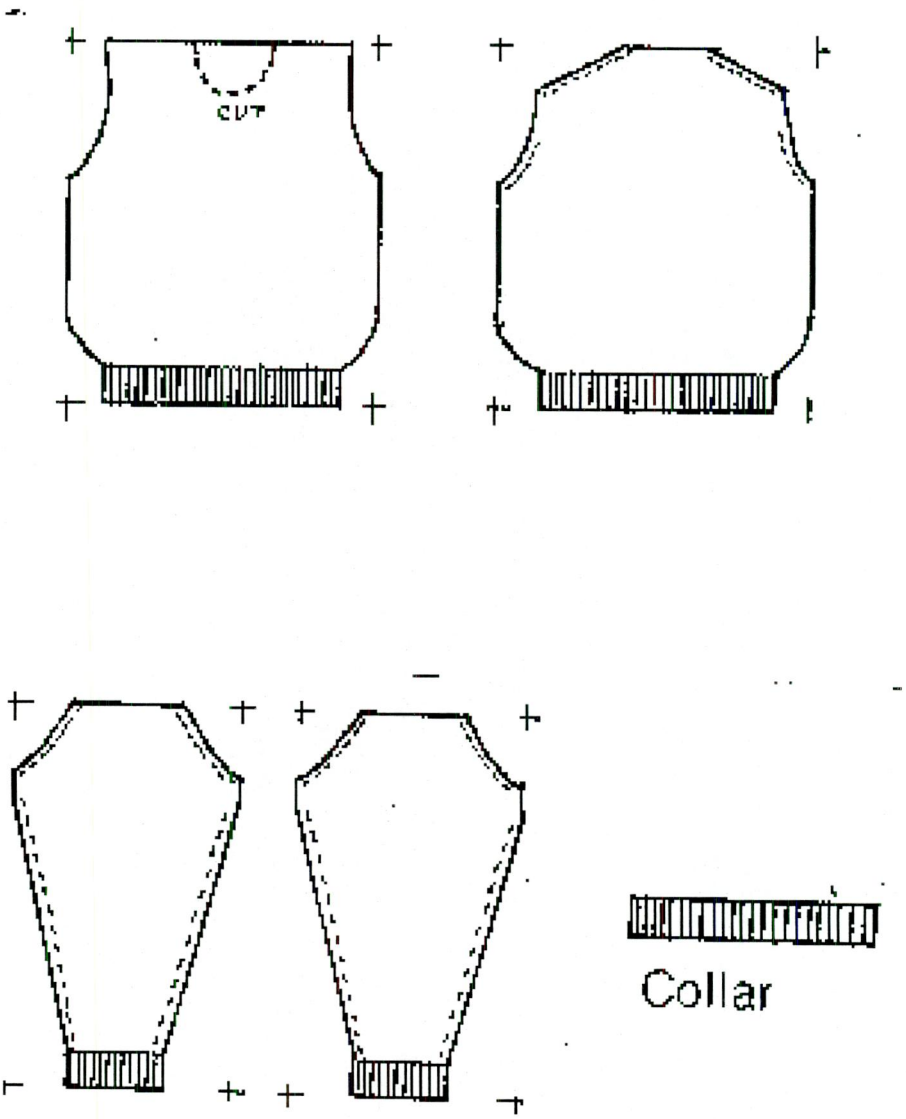

Fig 29. Illustrates a "fully fashioned" garment straight of a knitting machine.

The garments that pass this point are labelled with swing tags as illustrated in Fig 30. and promotional information. The garment is then put in plastic sleeves and heat-sealed.

Fig 30. Is a swing tag used on garments for promotional purposes.

© West End Knitwear

The garments that are stained are called spotted garments. These stains could be dust, dirt or oil that was picked up from the machinery. They go through a cleaning process. *West End Knitwear* has developed a machine that cleans and dries the garment and has patented the idea. It consists of metal pipes with holes in it, to allow more than one garment be cleaned at a time. A vacuum is made in the pipes and a liquid, especially mixed for stain removal is sprayed on the spot. The vacuum both sucks the dirt away and dries the spot. The garments are ready for packaging. The garments that are still soiled are washed at controlled temperatures and times.

Another piece of equipment that *West End Knitwear* has patented is a tool for bundling garments together. It is essential that pieces of a garment are kept together on an assembly line. Otherwise there are waste garments with pieces missing. The tool is a form of tie. John Cullen is very interested in outdoor activities and adapted the tie from a sailing implement.

At the end of my interview with John Cullen I asked him what did he think of *Stolls* Knit and Wear® and *Shima Seikis* Whole Garment® knitting machines. He felt that they were not for commercial production but rather for academia, for students like me to learn on. He did say that if a company were making 1,000 to 1,500 garments a week, it might be a good machine. That kind of production would be aiming for minimal assembly of garments. However, for mass production using these machines would be crazy because they take too long to programme.

I also asked John Cullen what did think of the future of Irish knitwear manufacturing. He said that the percentage of the knitwear market that Ireland had was getting smaller all the time. He spoke about a few years back before the large chain stores were getting their knitwear produced in the Far East, when *West End Knitwear* produced a large proportion of the knitwear for Penneys and Dunnes Stores. *West End Knitwear* used to produce both adult and children's knitwear. It was only around ten years ago that he had to rethink the future of *West End Knitwear,* it was then that he decided to go into specialised niche knitwear. John Cullen stressed that it was not a premeditated decision but rather a necessity to survive.

Conclusion

I found when I completed my investigation into CAD CAM technology in Irish knitwear that my original idea that this technology had a moment impact on the industry was wrong. I was shocked to find out that it happened as a gradual development from manual mechanical knitting machines to highly advanced computerised knitting machines. However, CAD CAM technology had many effects on the Irish knitwear industry.

It has had a big effect on garment production, thousands of garments can be produced a week automatically with supervision by an operator to make sure machine is knitting smoothly. Garments can now be produced almost fully finished and intricate design details involving gauge changes can be knitted with little ease. CAD CAM technology has effected production scale of Irish manufacturers, who can compete with foreign knitwear companies abroad due to the fact that they can meet market needs. This is evident with the knitwear companies that produce garments for the American market. Without CAD CAM technology they would never be able to produce enough Aran style garments or garment that have an Irish feel for that market.

I feel that CAD CAM technology has had a bigger impact on design. It was revolutionised the design room of many large knitwear companies in Ireland. I think *West End Knitwear* is a great example of the impact of computerised technology. Designing new collections has become very time efficient due to file libraries of stitches and patterns being created in most companies.

Overall CAD CAM technology has had a great effect on Irish knitwear even if was a gradual development.

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